

# Blue Bottle

## Purpose

To develop a model of a redox reaction where oxygen gas is the oxidizing agent.

## Materials

- Sodium hydroxide, NaOH
- Glucose, C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>
- Methylene blue (1% in isopropyl alcohol)
- 500-mL Erlenmeyer flask with rubber stopper
- Electronic balance

## Safety

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| <ul style="list-style-type: none"><li>• Read the SDS sheets for all chemicals before using them.</li><li>• Wear safety glasses, gloves, and lab coat.</li><li>• Sodium hydroxide is caustic. Handle with care.</li></ul> |
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## Procedure

1. Add 200 mL of water to the 500 mL Erlenmeyer flask.
2. Add 5.0 g of sodium hydroxide. Stir to dissolve.
3. Add 5.0 g of glucose. Stir to dissolve.
4. Add 50 mL of water to the solution in the flask.
5. Add about 10 drops of 1% methylene blue indicator.
6. Firmly seal the flask with the appropriate sized rubber stopper.
7. Let the blue solution sit undisturbed.
8. Shake the container several times after the solution becomes colorless, then leave undisturbed.

## Results

- The solution turns colorless upon standing.
- The contents of the flask are clear but turn blue upon shaking.
- When left undisturbed the flask contents turn clear.
- The process can be repeated several times.

## Follow-up Teaching Notes

- Make the solutions just prior to use.
- The oxygen that dissolves upon shaking oxidizes the colorless methylene blue, turning it blue.
- The glucose reduces the blue dye, turning it back to its colorless form.
- **Related Lab:** Ward's Science Lab Activity Oscillating Reactions: The Traffic Light (470219-088)
  - Uses 20 drops of indigo carmine solution (1% in water) or 4-5 small crystals instead of methylene blue and a green to red-orange to yellow transition occurs:
  - If yellow solution is shaken gently, it will turn red-orange in color.
  - If yellow solution is shaken more vigorously, the red-orange color solution will turn green in color.

## Connections

- Redox reactions, developing a model.
- Photochemical reactions in alternate demo.

## Extension

- Photochemical variation:
  - Add 2.0 g of iron(II) sulfate to 100 mL of 0.1 M sulfuric acid solution in a 250 mL Erlenmeyer flask.
  - Add a couple of crystals of methylene blue. Mix.
  - The solution should turn nearly colorless when placed on an overhead projector. (if it remains blue, then dilute the solution).

- Upon removal from the light, source the solution returns to blue color.

**Disposal/Clean-up**

- Neutralize the solution before washing the products down the drain (add dilute hydrochloric acid, <0.5 M, until the pH is approximately 7. Check local codes before starting any disposal activity.